

## COOPERATIVE AGREEMENT

This Cooperative Agreement is entered into between Leon County, Florida, a charter county and political subdivision of the State of Florida, hereinafter referred to as the "Sponsor", and Florida State University, for and on behalf of the Board of Trustees and their successors and assigns, hereinafter referred to as the "University".

Whereas, the Sponsor desires that the University perform certain services defined in attachment A and incorporated as a part of this Cooperative Agreement.

Whereas, the University has agreed to perform under the terms and conditions hereinafter set forth in this Agreement:

NOW THEREFORE, the parties hereto mutually covenant and agree as follows:

### SCOPE OF SERVICES

The Scope and description of the services are fully described and set forth in Attachment A of this Agreement.

### TERM

This Cooperative Agreement shall commence on October 1, 2005, and end on September 30, 2006. The period of performance under this Agreement is specified as October 1, 2005 through September 30, 2006, unless sooner terminated in accordance with the terms herein.

The Final Report for this agreement will be due no later than thirty (30) days following the completion of the project.

### TERMINATION

Either party hereto may terminate this Agreement at any time with or without cause upon thirty (30) days written notice. Termination or cancellation shall not affect the rights and obligations of the parties accrued prior to termination. In the event of termination, the Universities shall be paid for all costs incurred and obligations made prior to the termination date. All extensions shall be approved in writing by execution of an amendment to the Agreement by all parties.

### COST AND PAYMENT

The Sponsor agrees to pay the University, on a cost reimbursable basis, an amount up to \$165,000, for allowable expenses incurred according to the budget in Attachment B. Billing will be on a quarterly basis. Payment shall be made upon receipt of a proper invoice.

Invoices shall be sent to:

Leon County Solid Waste Management Division  
7550 Apalachee Parkway  
Tallahassee, FL 32311

Payments shall be sent to:

Sponsored Research Accounting Services  
97 South Woodward Avenue, 3<sup>rd</sup> Floor  
Tallahassee, Florida 32306-4166

The final invoice from the University is due thirty (30) days after the completion of the project.

#### PATENT AND COPYRIGHT

The University shall retain rights to any and all intellectual property first produced under this Agreement. If this Agreement is funded in whole or in part with federal funds, the University grants to the Federal Government a royalty-free, nonexclusive, irrevocable license to use the intellectual property first produces under this Agreement.

#### MODIFICATIONS

Modifications of the provisions of this Agreement shall be valid when they have been reduced to writing and duly signed by authorized parties.

#### INDEMNIFICATION

Each party hereto agrees that it shall be responsible for the wrongful acts of its employees, contractors and agents. However, nothing contained herein shall constitute a waiver of sovereign immunity by the parties and the limitations set forth in Section 768.28, Florida Statutes.

#### INSURANCE

Each party agrees to maintain, during the term of this Agreement, comprehensive general liability insurance with limits for bodily injury and property damage combined in the amount of \$100,000 per person, \$200,000 per occurrence for the protection of the parties against any and all claims arising out of this Agreement.

#### MANAGEMENT

The Sponsor has designated Adam Schlachter as the contact person for this Agreement, telephone # 850-414-9346.

The University's representative for the technical aspect of the project is Tarek Abichou, telephone # 850-410-6661. The representative for the University responsible for administrative and financial matters related to this Agreement is Dr. Kirby W. Kemper, Vice President for Research, telephone 644-5260.

SEVERABILITY AND NON-WAIVER

In the event one or more provisions of this Agreement are declared invalid, the balance of this agreement shall remain in full force and effect. Failure of either party to enforce any provision of this Agreement does not waive that party's right to full performance of the provisions of the Agreement.

It is expressly understood and agreed that this Agreement states the entire agreement and that the parties are not bound by any stipulations, representations or promises not printed in this Agreement.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed by their undersigned officials as duly authorized.

LEON COUNTY, FLORIDA

BY: \_\_\_\_\_  
Cliff Thael, Chairman  
Board of County Commissioners

ATTEST:  
Bob Inzer, Clerk of the Court  
Leon County, Florida

BY: \_\_\_\_\_  
Approved as to Form:  
Leon County Attorney's Office

BY: \_\_\_\_\_  
Herbert W.A. Thiele, Esq.  
County Attorney

FLORIDA STATE UNIVERSITY

BY: \_\_\_\_\_  
Kirby W. Kemper  
Vice President for Research

## ATTACHMENT A.

**Innovative Recycling/waste Reduction Grant:  
Beneficial Reuse of Waste Materials (tire chips, glass cullet, M1 tire steel and  
yard waste) to Control Odors and Methane Release from Landfills**

**PROJECT ABSTRACT**

Florida State University proposes to team-up with Leon County to use tire chips, M1 steel (a waste product from the chipping of tires for which there is currently no use whatsoever), glass cullet, ground pallets and yard waste to construct (1) bio-cells capable of reducing odors and methane and organic compound emissions and (2) iron-containing cells to capture odorous sulfur gas emissions from landfills. The waste materials, tire chips, glass cullet and M1 steel, will be mixed with mulched yard waste and ground pallets and applied to the landfill surface as a "biocover." The bio-cells will serve as attachment sites for methanotrophic bacteria and as a place for the reduced gases (methane and  $H_2S$ ) to mix and co-mingle with  $O_2$  in the presence of bacteria and tire iron. These bacteria specifically oxidize methane and other odor producing gases to form biomass and carbon dioxide (odorless). Hot spots of gas emission on the landfill surface will be identified with a portable gas analyzer. Emissions will be quantified and then a treatment of either glass cullet or waste tire chips mixed with compost will be applied. Different treatments will be investigated. Laboratory and field studies will be conducted to optimize the mobilization of iron from M1 steel in a field bio-cell application. Iron is quite reactive to hydrogen sulfide, a particularly foul smelling toxic compound that is released from C&D landfills from the decay of gypsum in sheetrock or wallboard. We anticipate that the iron in M1 steel can be used to sequester hydrogen sulfide as inert iron sulfide minerals. This project would target waste tires, which have a disposal fee and fund Florida's Solid Waste Management Trust Fund. M1 steel has no use and is land-filled. We calculate that a 1 meter thick cover spread over an acre would use roughly 4500 cubic yards of waste material.

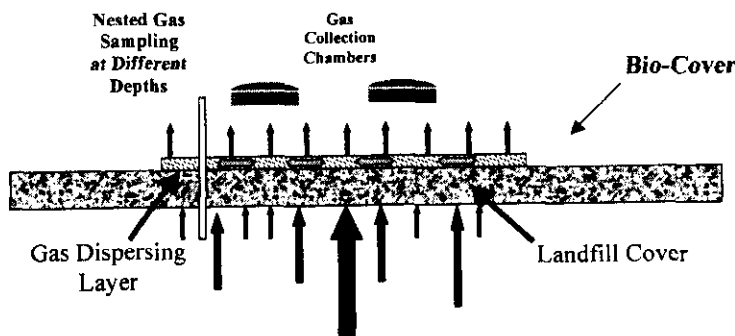
## PROJECT DESCRIPTION

Leon County Landfill and many other landfills across the state and country process various waste products which can cause emissions of odors associated with the decomposition of buried waste. Waste decomposition in a modern landfill occurs under anoxic conditions resulting in the formation of reduced gases such as methane ( $\text{CH}_4$ ), hydrogen sulfide ( $\text{H}_2\text{S}$ ) and volatile reduced hydrocarbons (non-methane organic compounds, NMOCs). In larger landfills, federal regulations require active gas collection and flaring, but in smaller older facilities these systems are not required and are not economical. Gas collection systems are also not required in C&D landfills. However, in all landfills, even landfills with gas collection systems, hot spots of gas release develop due to heterogeneity in the buried waste or soil cover, weaknesses in the soil cover or drying and desiccation followed by cracking of the soil itself. The Sponsor proposes to use mixtures of *tire chips, M1 steel, glass cullet, ground pallets and mulched yard waste* to treat and eliminate the odorous emissions.

Within the oxidized outer layer of soil covering landfills bacteria reside which specialize in consuming methane and NMOCs, thus attenuating their release to the atmosphere. Efforts have been devoted towards the design of approaches for measuring the effectiveness of these bacteria and for designing covers that optimize their performance. The reactivity of hydrogen sulfide ( $\text{H}_2\text{S}$ ) has not been determined in these systems, but  $\text{H}_2\text{S}$  participates readily in chemical reactions with iron and oxygen, and can

react to form either elemental sulfur or iron minerals, both of which are relatively inert.

The Sponsor proposes to construct biocells to oxidize methane and NMOCs, and iron-containing cells to oxidize and consume  $\text{H}_2\text{S}$



using waste materials: tire chips, M1 steel, glass cullet and mulched yard waste and pallets. These cells would be designed to enhance both biological and chemical oxidation

of reduced gases. The cells would be placed over emission hotspots located by visual inspection and with a portable gas analyzer. Gas emissions would be quantified before and after placing the proposed cells over the hot spots and the effectiveness of the biocell in reducing gas emission would be monitored over time. The idea is to construct an area where prolonged contact of the reduced gases and oxygen can co-mingle in the presence of bacteria, iron and moisture thus providing an optimum environment for the elimination of these odorous and infrared active compounds. The biocells will be constructed based on the previous experience developed by the team in designing compost biocells. Laboratory testing will be performed to optimize the effectiveness of steel shards in tire scraps (M1 steel) for the sequestration of  $H_2S$  through its reaction with iron. A field scale trial over a C&D landfill will then be constructed.

The Sponsor has access to instrumentation to measure and analyze methane and hydrocarbon gases, but requests funds to purchase and set up a state of the art facility for the analysis of sulfur gases including but not limited to  $H_2S$ . This would allow us to address the effectiveness of our recycling effort in the reduction of odors from landfills in a quantitative way.

**Project Scope:**

**Task 1.** Purchase and set up gas chromatograph and chamber equipment to measure sulfur gas emissions from landfills. Specialized equipment is required to measure the response of Sulfur gas emissions to the bio-cell and M1 steel cell treatments. We will use Teflon dynamic chambers to measure gas emissions and a gas chromatograph with a Flame Photometric detector to measure Sulfur gas concentrations. Chanton (FSU) has considerable experience with gas chromatography. Additionally a permeation tube device is required to calibrate the gas chromatograph. This task will be performed by FSU/FAMU College of Engineering.

**Task 2.** Survey the landfill with a portable methane emission detector to locate hot spots of landfill gas emission. We possess a portable device with a flame ionization detector which we can use to survey the landfill for gas emission hotspots. With a GPS we will locate these spots. This task will be performed by FSU/FAMU College of Engineering.

**Task 3.** Measure gas emissions from hot spots prior to treatment with bio-cells and chem.-iron cells. We will use our chamber techniques and measure methane and hydrocarbon gases emissions from a number of "hot spots" of landfill gas emission prior to treatment. Sulfur gas emissions will be treated in a separate task below. Methane concentrations will be measured by flame ionization gas chromatography in our lab at FSU/FAMU. This task will be performed by FSU/FAMU College of Engineering.

**Task 4a.** Tire transportation and processing Contractor, American Rubber Technologies to shred and haul tires. This Task will be performed by the Leon County Landfill.

**Task 4b.** Construction of biocells. This task will be performed by FSU/FAMU College of Engineering in conjunction with landfill personnel.

**Task 4c.** Install thermocouples, water content reflectrometers at several depth of the biocover to monitor temperature and water content. Install data collection system powered with solar panel and rechargeable battery. This task will be performed by FSU/FAMU College of Engineering

**Task 5.** Monitor emissions from biocells, following their construction for 9 months. Methane and NMOC emissions would be monitored with the chamber techniques and FID gas chromatography as described in Task 3. NMOC's will be measured at a lab in

California. The testing will be performed as an expense since these the Lab will charge per sample.

**Task 6.** Lab studies to maximize sulfide uptake by M1 steel. Initial column studies in the laboratory will investigate the best ways to mobilize the M1 steel to increase its availability to sulfur. Variables studies will be exposure to moisture, oxygen and grain size and packing density of the M1 steel. This task will be performed by FSU/FAMU College of Engineering

**Task 7.** Construct field biocell with M1 steel on C&D site. This task will be performed by FSU/FAMU College of Engineering

**Task 8.** Measure gas emissions from M1 steel biocell. We will use Sulfur gas chambers and analyzer. This task will be performed by FSU/FAMU College of Engineering

**Task 9.** Manage and administer project. This task will be performed jointly with Leon County

**Task 10.** Prepare quarterly and final reports. This task will be performed jointly with Leon County

**Task 11.** Transfer information gained in this project. This task will be performed by FSU/FAMU College of Engineering



**Attachment B.**

<b>Category</b>	
<b>Personnel</b>	
<b>Senior Personnel</b>	
PI (Tarek Abichou)	\$5,750
PI Jeff Chanton	\$7,500
PI Kamal Tawfiq	\$7,500
Dave Powelson	\$23,500
<b>Other Personnel</b>	
Grad Student	\$15,300
Undergrad Student	\$9,000
<b>Total Personnel Cost</b>	<b>\$68,550</b>
<b>Fringe Benefit</b>	
Senior Personnel (18.37%)	\$8,129
Grad Student (0.3%)	\$46
Undergrad Student (0.3%)	\$27
<b>Total Fringe Benefits</b>	<b>\$8,202</b>
<b>Travel</b>	
Trip 1	\$1,000
Trip 2	\$1,000
Trip 3	\$1,000
<b>Total Travel Cost</b>	<b>\$3,000</b>
<b>Equipment</b>	
GC & Gerard meter	\$22,000
Data acquisition & Calibration system	\$9,000
<b>Total Equipment</b>	<b>\$31,000</b>
<b>Supplies/Equipment rentals</b>	
chambers	\$8,000
Thermocouples	\$2,000
TDR and lab supplies	\$9,758
pipes, fittings	\$5,000
Rentals (Bobcat, dozer)	\$12,000
<b>Total Supplies/rentals</b>	<b>\$36,758</b>
<b>Other Direct Cost: Outside lab Testing hydrocarbon analysis</b>	<b>\$6,000</b>
<b>Tuition</b>	<b>\$5,365</b>
<b>Total Direct Cost</b>	<b>\$158,875</b>
<b>Indirect Costs</b>	
5% (direct cost - Equipment-Tuition)	\$6,125
<b>Total Indirect Costs</b>	<b>\$6,125</b>
<b>Total Project Cost</b>	<b>\$165,000</b>

**Budget Justification**

The budget includes a partial month of summer salary for Tarek Abichou, Jeff Chanton, and Kamal Tawfiq. The salaries for the investigators are warranted given the level of effort required, particularly during weekly meetings, laboratory testing, and data analysis. The faculty are on 9 month appointments and must raise their own summer salary, 25% of their total. Partial funding is also requested for assistant in research David Powelson. Their fringe benefit rate is 18.37%. One full time graduate student will be appointed time at the FAMU-FSU College of Engineering, to conduct laboratory and field work. The fringe benefit rate for the graduate student is 0.3%. A partial salary an Assistant in research is also requested. An undergraduate student will also help with lab and field work.

Equipment: A gas chromatograph and a Gerard meter will be purchased along with a data collection system and a gas calibration system.

Supplies: Chambers and Bases: We need to construct additional chambers and chamber bases for measuring methane emissions and collecting the emitted methane for isotopic analysis. Chambers are needed for Sulfur gas work. We also need to standard gases. Various supplies will be needed for the field and laboratory work to construct the column test apparatus including sampling containers, valves, fittings, standards, gases, nasal ranger, liquid nitrogen and sampling ports. An additional amount is allocated for the purchase of the necessary devices to measure gas flow rate, concentration at the inflow and outflow sides of the samples. These amounts are based on experience of the PIs.

NMOC (non-methane hydrocarbon analysis will be performed by an outside contractor in Irvine California who has considerable experience in this area and with whom we have prior (excellent) experience (Scheutz et al., 2003).

Equipment will also be rented (Bobcat, Dozer) to construct the biocells in the field.

Travel funds are also included to cover travel associated with the presentation of the results of the project in conferences, workshops, and meetings and to allow us to keep up with the field.

Graduate students tuition reimbursement is allotted as required by the University and is budgeted to be \$5365.

An indirect cost rate of 5% is applied for this project since the funding is from the State of Florida.